REMARKS

In the Office Action dated February 23, 2004, claims 1-19 are pending and all claims are rejected.

The above amendment is submitted to more particularly point out and distinctly claim the subject matter regarded as invention. Support for the amendment can be found throughout the original specification and drawings.

Objection is made to the drawings. The Examiner states that Figures 7, 8a, 8b, 8c, 9a, 9b, 10a, 10b, 11a and 11b should be designated as prior art allegedly because only that which is old is illustrated. Applicant agrees that the figures can be found in U.S. 6,002,255, also by present Applicant. However, it is submitted that the drawings are provided in this application as a teaching of how to make and use the present invention, namely, how to provide planar gradient fields for use with the present invention. Therefore, because these figures are relevant to the description for making and using the present invention, it is not considered appropriate to label them as prior art.

Claims 1, 2, 7, 8 and 13-19 are rejected under 35 U.S.C. §102(b) over Pulyer (US 6,002,255). The examiner alleges that Pulyer '255 teaches the planar MRI system of claim 1 [citing col. 9, lines 29-36; Figures 6A, 6B, 6C; col. 5, lines 25-35; col. 6, lines 29-38; Figures 5a, 5b; col. 6, lines 24-29]. Applicant strongly disagrees.

Although Pulyer '255 describes a planar open magnet MRI system having a remote region of substantial field homogeneity, the manner of providing the remote region of substantial field homogeneity is substantially different. Pulyer '255 teaches a magnet configuration with a primary magnet system having <u>spaced primary **field emission surfaces**</u> and, located between the <u>spaced primary **field emission surfaces**</u>, a bias magnetic system having <u>spaced bias **field emission surfaces**</u>. The field emission surfaces are the pole pieces of a primary magnet or planar surfaces at the poles ("flux emitting ends"). [See, col. 3, lines 21-30.]

Pulyer '255 also teaches that "the side of the magnet system opposite the target region is shunted by a planar <u>**ferromagnetic core back plate**</u>, which <u>**accommodates return flux**</u> and enhances magnet efficiency. The cross sectional area of the back plate can be made to have any predetermined value to keep the ferromagnetic material at <u>**saturation point**</u>." [Col. 5, lines 29-35.]

As discussed in the present application at page 6, line 17 *et seq.*

> a fundamental problem for obtaining an open magnet having maximal accessibility for a surgeon to conduct MRI guided surgery results from the fact that conventional magnet systems exhibit a substantial drop in magnet efficiency when providing an open volume of magnetic field that is large enough for surgery to be conducted therein. Conventional iron core C-type magnet configurations provide a target field volume between co-axial pole pieces. That type of magnet configuration, even with air gap enlargement (reducing magnet efficiency), still has limited accessibility for MRI guided surgery. MRI magnet systems in the form of one side "pancake type" magnet configurations (e.g. U.S. 5,331,282) generally have a set of coaxial circular coils with alternating polarity and axially shifted positions and provide relatively low level of remoteness and require a large diameter magnet for adequate field strength, thus, inhibiting accessibility to the region of field homogenity. So-called "open"

> solenoid superconductive magnets (e.g., U.S. 5,677,630) provide better accessibility and larger field of view (FOV) but accessibility still is limited by axial distance between two solenoidal magnets (which typically is about the width of a person's shoulders). The planar open magnet systems mentioned above (e.g., U.S. 5,378,988; U.S. 5,744,960; U.S. 5,914,600 and U.S. 6,002,255) provide complete openess for excellent accessibility but suffer still from a limitation in magnet efficiency.

In contrast, the magnetic field of the present invention is provided by the ferrorefraction principle. No poles pieces or field emission surfaces or "flux emitting ends" are required or desired. Instead, the magnetic field is provided by a pair of spaced parallel current wires can be refracted and magnified substantially by a planar ferromagnetic core that is structured and arranged to provide a substantial orthogonal ferrorefraction effect, which provides the effect of generating a set of mirror image current wires of the same polarity. [See, application page 7, lines 18-22.]

Thus, the magnetic field of the prior art is produced by flux emitted at the magnet poles or field emitting surfaces whereas, in contrast, the present invention produces the magnetic field with parallel current wires using an orthogonal ferrorefraction boundary.

In Pulyer '255, "FIGS. 6A, 6B and 6C illustrate the construction of one portion of a primary magnet system 60 with a ferromagnetic core 61 for **return flux**, a primary coil 62, and a ferromagnetic **pole piece** 63." [Emphasis added; col. 9, lines 29-32.]

In Pulyer '255, "FIG. 5B is a side view illustrating field along the X-axis generated by the pair of unipolar rectangular solenoidal shimming coils of FIG. 5A."

[Col. 6, lines 24-29] Clearly, the ferromagnetic core in FIG. 5A is U-shaped (or C-shaped), not substantially planar. Thus, FIG. 5A ***fails*** to teach a ferromagnetic core having a **substantially planar core surface layer** and a longitudinal axis and a unipolar current wire pair on a side of and adjacent to the planar core surface layer, the wire pair being separated along said longitudinal axis, as presently claimed.

The Examiner noted that Pulyer '255 "teaches using adjacent components, to the ferromagnetic core and ferromagnetic pole piece, oriented at right angles (i.e., orthogonal) to reduce current eddies across structural components." This refers to the relationship of layers of magnetic material used to build the ferromagnetic core and pole pieces, as best illustrated in FIGS. 6A, 6B and 6C. There is not even a hint of a suggestion in Pulyer '255 for using ferromagnetic core providing an orthogonal refractory effect, as claimed herein.

Pulyer '255 is primarily directed to describing planar shimming arrays that are useful on the pole field emitting surface. These arrays are not capable of providing an orthogonal refractory effect for various reasons including the fact hat they are closed loop wire arrays on a planar surface, e.g., 17a, 17b in FIG. 1B.

Thus, there is no teaching or even a hint of a suggestion in Pulyer '255 for providing a magnetic field having a remote region of substantial magnetic field homogeneity for a MRI system using an orthogonal ferrorefractory effect. Further, there is no teaching or even a hint of a suggestion in Pulyer '255 for how to provide a magnetic field having a remote region of substantial magnetic field homogeneity for a

MRI system using an orthogonal ferrorefractory effect. Clearly, there is no teaching or suggestion for the beneficial results obtained by providing a magnetic field having a remote region of substantial magnetic field homogeneity for a MRI system using an orthogonal ferrorefractory effect. Indeed, Applicant is the first to teach and show how to do so.

With respect to claim 2, Applicant teaches that it is necessary only to have a surface layer of ferromagnetic material, preferably near saturation, in order to provide the ferrorefractory effect. In contradistinction, the prior art and Pulyer '255 teach that the ferromagnetic core must provide for the return flux of the pole pieces as well as typically being at saturation. Surprisingly, the present invention shows that it a strong magnetic field can be provided by a ferrorefractory effect without providing for consideration of a return flux in a ferromagnetic core, because the field in accord with the present invention is not provided by the pole field emitting surfaces. This is a substantial departure from the prior art, including Pulyer '255.

Claim 7 is directed to providing an orthogonal geometry of ferromagnetic material adjacent to the wire. The layered plates of the ferromagnetic core and pole in Pulyer '255 do not provide the ferrorefractory effect and the location of the wires have no relevance to the layered plates as taught by Pulyer '255.

In the planar open magnet MRI system of Pulyer '255, the plane for the open magnet MRI system is defined by the pole pieces. In the present invention, the plane

for the MRI system is defined by the substantially planar core surface layer of the ferromagnetic core. The difference is substantial.

The Examiner states the Pulyer '255 suggests ferromagnetic end plates that extend perpendicular to the ferromagnetic core. In Pulyer '255, all of the ferromagnetic material between the pole pieces is the ferromagnetic core. This entire core must be designed to accommodate the return flux. There is no end plate perpendicular to the ferromagnetic core. The pole piece is not an end plate, as claimed herein. The pole piece provides a field emitting surface. The end plate of the present invention provides refractory effect for the current wires.

The Examiner repeatedly refers to layered plates in Pulyer '255. These layered plates are not relevant to the present invention. In Pulyer '255, as is well known in the field, the ferromagnetic core is made of layered plates to reduce eddies and increase efficiency of carrying the return flux. In the present invention, it is not relevant to consider the return flux.

Thus, it is not seen how the present invention is taught to one of ordinary skill in the art by Pulyer '255.

Claims 3-5 and 9-11 are rejected under 35 U.S.C. §103(a) over Pulyer '255. These claims also are patentable at least for the same reasons as discussed above.

Claims 6 and 12 are rejected under 35 U.S.C. §103(a) over Pulyer '255 in view of Mallard et al. (US 4,656,449). Pulyer '255 is discussed in detail above. Mallard fails to make up for any of the deficiencies of Pulyer '255. Indeed Mallard described a typical prior art C magnet having a ferromagnetic core with at least one substantially C-shaped yoke. There is no teaching or suggestion for providing a remote homogeneous field. In Mallard, the area of homogeneity is in the air gap between the poles. Thus, one of ordinary skill in the art would not combine Mallard with Pulyer '255, which provides a remote area having a homogeneous field. Mallard and Pulyer '255 teach incompatible concepts.

Thus, it is not seen how the present invention would have been obvious to one of ordinary skill in the art in view of Pulyer '255 or any combination of cited art.

It is respectfully submitted that the subject application is in a condition for allowance. Early and favorable action is requested.

If for any reason a fee is required, a fee paid is inadequate or credit is owed for any excess fee paid, the Commissioner is hereby authorized and requested to charge Deposit Account No. **04-1105**.

Respectfully submitted,

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